WHAT IS CLAIMED IS:

1. An optical device comprising a periodic multilayer structure, wherein an end surface of said multilayer structure which is not parallel to layer surfaces of said multilayer structure is used as at least one of a beam incidence surface and a beam exit surface.

2. An optical device according to Claim 1, wherein the length a of one period in said periodic multilayer structure with respect to a wavelength λ used is in a range given by an expression:

$$\lambda/2n_M \leq a$$

in which n_M is an average refractive index in the one-period range of said multilayer structure in the wavelength λ.

3. An optical device according to Claim 1, wherein said one period in said periodic multilayer structure is constituted by layers formed out of different materials.

4. An optical device according to Claim 1, wherein a layer varying continuously in terms of composition or characteristic is contained in a boundary between every two layers constituting said periodic multilayer structure.

5. An optical device according to Claim 1, wherein a maximum refractive index difference between a plurality of materials constituting said periodic multilayer structure is not smaller than 0.1 in a wavelength used.

6. An optical device according to Claim 1, wherein an

end surface of said periodic multilayer structure on which beam is incident crosses said layer surfaces of said multilayer structure perpendicularly.

7. An optical device according to Claim 1, wherein an end surface of said periodic multilayer structure from which beam is made to exit crosses said layer surfaces of said multilayer structure.

8. An optical device according to Claim 1, wherein an end surface of said periodic multilayer structure on which beam is incident and an end surface of said periodic multilayer structure from which beam is made to exit are parallel to each other.

9. An optical device according to Claim 1, wherein said periodic multilayer structure is an optical multilayer film in which one structure formed on a transparent substrate is repeated with respect to a wavelength used.

10. A spectroscopic apparatus comprising: an optical device constituted by a periodic multilayer structure as defined in Claim 1; means for making a mixture of various luminous flux having a plurality of wavelengths incident on a beam incidence end surface of said optical device; and means for detecting beam rays made to exit from a beam exit end surface of said optical device at different angles in accordance with said wavelengths.

11. A spectroscopic apparatus according to Claim 10, wherein: said periodic multilayer structure is an optical multilayer film in which one structure formed on a surface of

a transparent substrate is repeated with respect to a wavelength used; and beam rays made to exit from said multilayer film toward said substrate are totally reflected in the inside of said substrate and taken out from an end surface of said substrate.

12. An optical device according to Claim 1, wherein the periodic multilayer structure is regarded as a one-dimensional photonic crystal, the end surface used as the beam incident surface is approximately perpendicular to said layer surfaces of said multilayer structure, and at least one surface parallel to said layer surfaces is provided as a beam exit surface.

13. An optical device according to Claim 12, wherein a length of one period is a and satisfies a condition given by an expression:

$$\lambda_0/2n_M \leq a$$

when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_0 in vacuum.

14. An optical device according to Claim 13, wherein a condition:

$$0 < k_S \cdot \lambda_0/(2\pi \cdot n_S) < 1$$

is satisfied when k_S is a magnitude of a wave vector of a coupled band as a not-lowest-order band in said photonic crystal with respect to said wavelength λ_0 in a direction which is parallel to said layer surfaces and which does not have any periodic structure, and n_S is a refractive index of a medium tangent to said surface

parallel to said layer surfaces and serving as said beam exit surface of said multilayer structure, with respect to said wavelength λ_0.

15. An optical device according to Claim 1, wherein said periodic multilayer structure is regarded as a one-dimensional photonic crystal, a surface parallel to said layer surfaces of said multilayer structure is provided as said beam incidence surface, and said one end surface used as the beam exit surface is approximately perpendicular to said layer surfaces.

16. An optical device according to Claim 15, wherein a length of one period is a and satisfies a condition given by an expression:

$$\lambda_0/2n_M \leq a$$

when n_M is an average refractive index in one period of said periodic multilayer structure with respect to beam with a wavelength λ_0 in vacuum.

17. An optical device according to Claim 16,

wherein a condition:

$$0 < k_s \cdot \lambda_0/(2\pi \cdot n_s) < 1$$

is satisfied when k_s is a magnitude of a wave vector of a coupled band as a not-lowest-order band in said photonic crystal with respect to said wavelength λ_0 in a direction which is parallel to said layer surfaces and which does not have any periodic structure, and n_s is a refractive index of a medium tangent to said surface parallel to said layer surfaces and serving as said beam incidence

surface of said multilayer structure, with respect to said wavelength λ_0.

18. An optical device according to Claim 14 or 17, wherein said coupled band is a second coupled band from a lowest-order band.

19. An optical device according to Claim 14 or 17, wherein a condition given by an expression:

$$\cos 60^\circ \leq k_s \cdot \lambda_0 / (2\pi \cdot n_s) \leq \cos 20^\circ$$

is satisfied.

20. An optical device according to Claim 14 or 17, wherein said k_s satisfies a condition:

$0.9k_1/m \leq k_s \leq 1.1k_1/m$ (m is an integer not smaller than 2)

when k_1 is a magnitude of a wave vector of the lowest-order coupled band.

21. An optical device according to Claim 14 or 17, wherein said medium tangent to said surface of said multilayer structure provided as said beam incidence surface or as said beam exit surface is air or vacuum.

22. An optical device according to Claim 14 or 17, wherein: said periodic multilayer structure is an optical multilayer film in which one structure formed on a transparent substrate is repeated periodically with respect to a wavelength used; and a surface of said multilayer film tangent to said substrate is provided as said beam incidence surface or as said beam exit surface.

23. An optical device according to Claim 14 or 17, wherein said one period in said periodic multilayer structure is constituted by layers formed out of difference materials.

24. An optical device according to Claim 14 or 17, wherein a layer varying continuously in terms of composition or characteristic is contained in a boundary between every two layers constituting said periodic multilayer structure.

25. An optical device according to Claim 14 or 17, wherein a ratio of a maximum refractive index to a minimum refractive index of a plurality of materials constituting said periodic multilayer structure is not smaller than 1.1 in a wavelength used.

26. A spectroscopic apparatus comprising an optical device constituted by a periodic multilayer structure as defined in Claim 14 or 17, means for making a mixture of various luminous flux having a plurality of wavelengths incident on an end surface of said multilayer structure of said optical device, and means for detecting beam rays made to exit from a surface of said multilayer structure at different angles in accordance with the wavelengths.

27. A polarization separating apparatus comprising an optical device constituted by a periodic multilayer structure as defined in Claim 14 or 17, means for making a mixture of various luminous flux having a plurality of wavelengths incident on an end surface of said multilayer structure of said optical device, and means for detecting beam rays made to exit from a surface

of said multilayer structure at different angles in accordance with polarized beam components.